What will Electric Utility Regulation and Business Models Look Like in 2030?

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Outline

- Trends shaping electric utility regulatory and business environments
- Concerns among policymakers, utilities, and customers
- Alternative regulatory and business models under rate-of-return regulation
- More substantial and fundamental shifts in regulatory and business models being considered

Which quote is from 1991?

"…economic fundamentals and public policies in place are likely to encourage **significant future disruption to the utility business model**."

"Want to start an argument? Ask a roomful of utility executives if the traditional regulatory compact makes sense…Most electric utilities have had smooth sailing for the past several years. **But the seas are about to get rougher**."

"It's a [business] model that hasn't changed much since Thomas Edison invented the light bulb. **And it's doomed to obsolescence**."

Déjà vu?

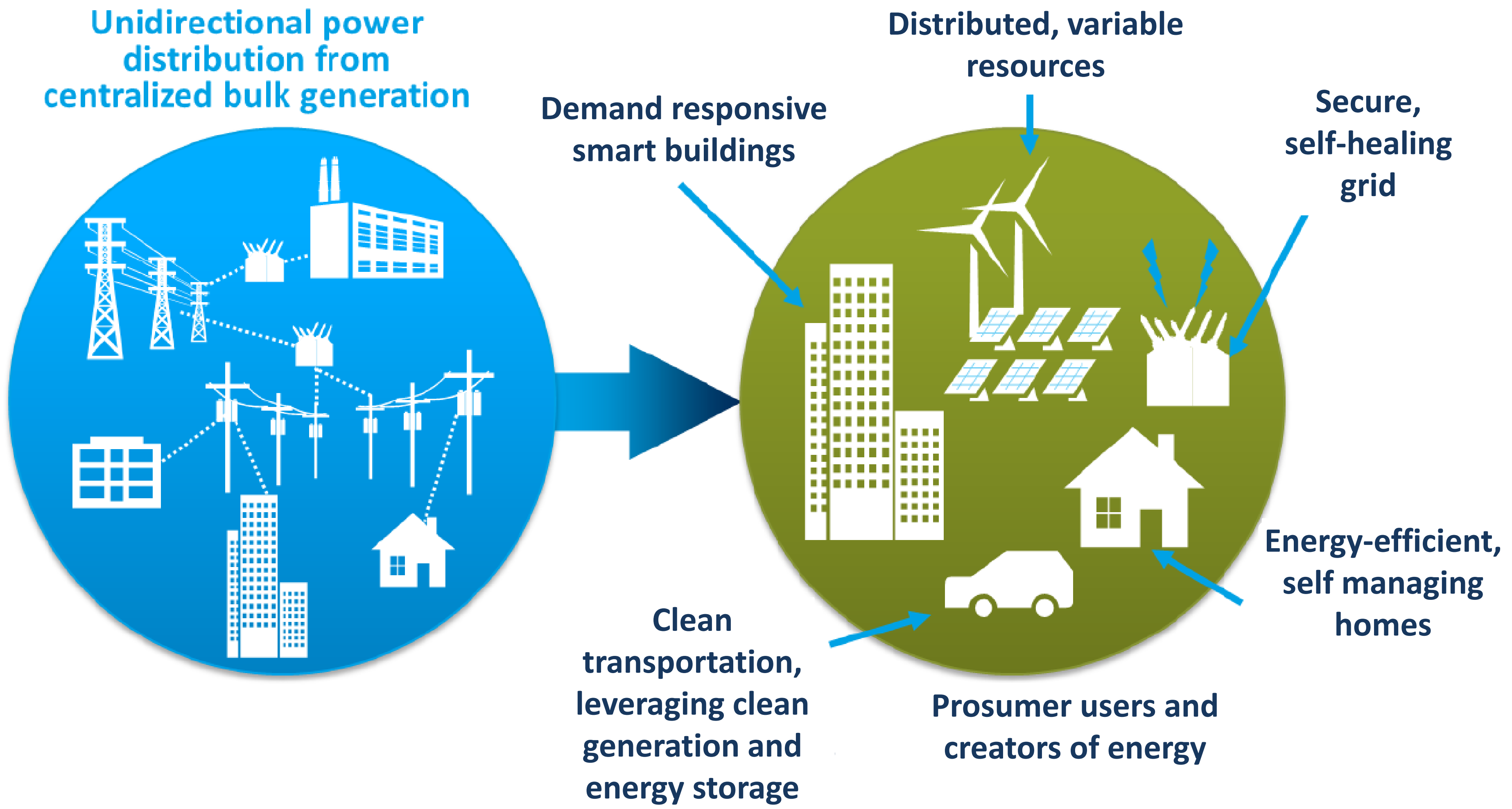
“…economic fundamentals and public policies in place are likely to encourage **significant future disruption to the utility business model**.” Edison Electric Institute – January 2013

“Want to start an argument? Ask a roomful of utility executives if the traditional regulatory compact makes sense…Most electric utilities have had smooth sailing for the past several years. **But the seas are about to get rougher**.” Public Utilities Fortnightly– April 1991

“It’s a [business] model that hasn’t changed much since Thomas Edison invented the light bulb. **And it’s doomed to obsolescence**.” Bloomberg BusinessWeek – August 2013

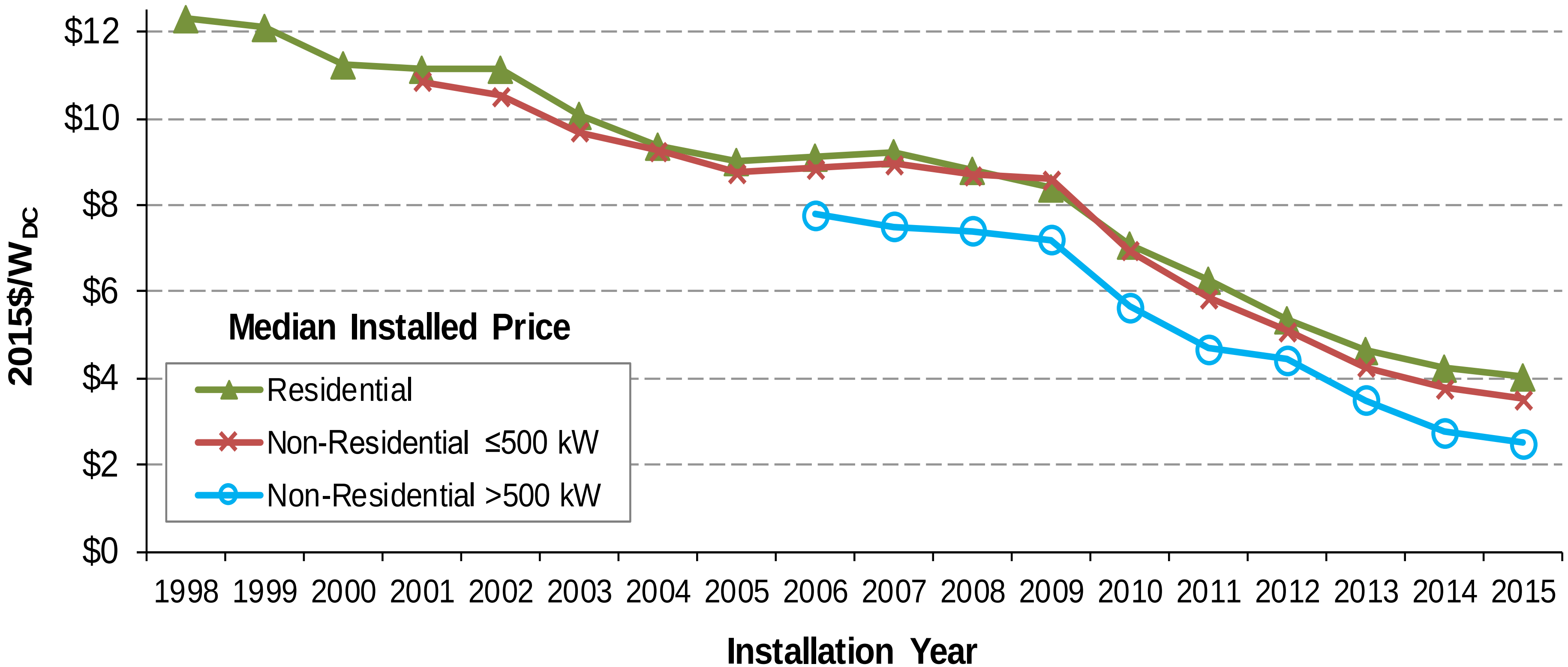
Trends shaping the electric utility regulatory and business environment

Transition to a more distributed energy future



Installed distributed solar PV prices continued to decline

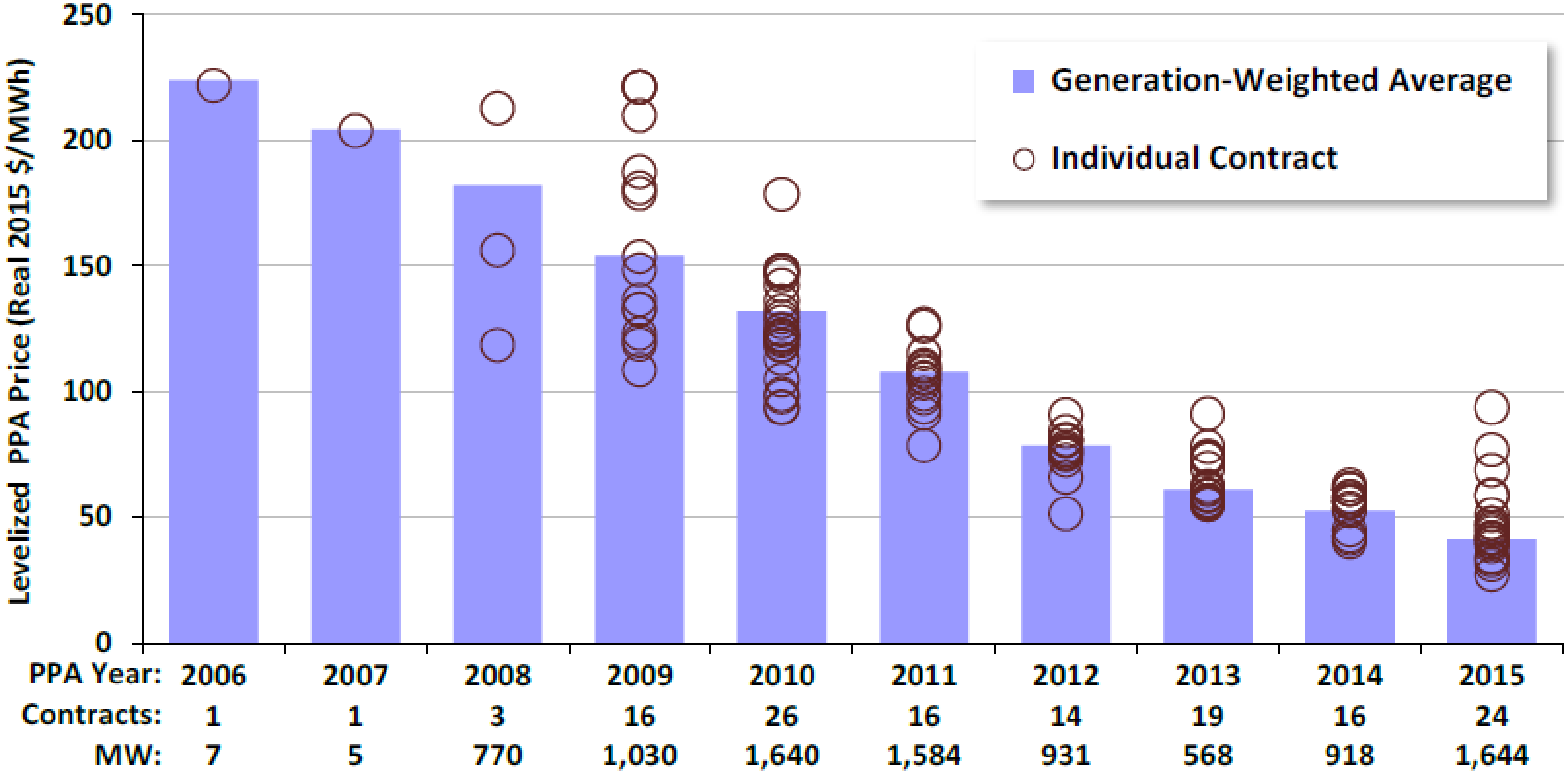
Median installed prices fell by 5-7% from 2014 for residential and small non-res systems and by 9% for large non-residential systems



Notes: Median installed prices are shown only if 20 or more observations are available for a given year and customer segment.

Source: G. Barbose and N. Darghouth (2016) "Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States." LBNL Report No. 1006036

Strong downward pricing trend in utility-scale solar since 2006

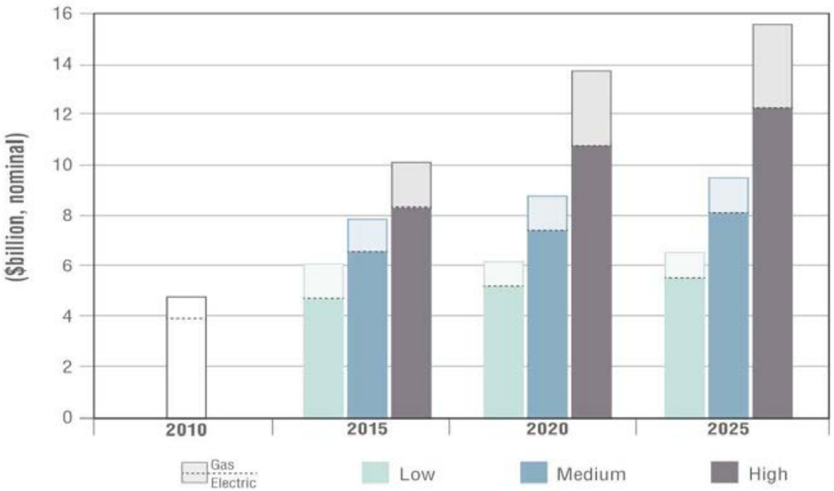


- Levelized PPA prices now less than ~$50/MWh
- Two-thirds of sample has flat annual PPA pricing (in nominal dollars), while the rest escalate mostly at low rates intended to keep pace with inflation

Source: M. Bolinger and J. Seel (2016) "Utility Scale Solar 2015: Empirical Analysis of Project Cost, Performance and Pricing Trends in the U.S." LBNL Report No. 1006037

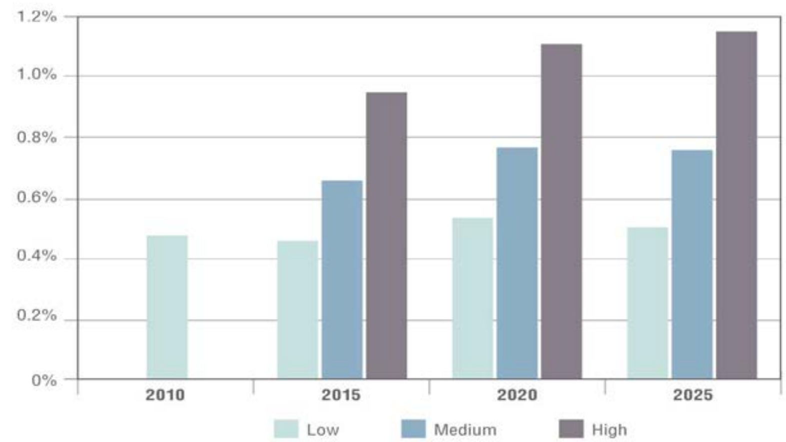
Electric savings could offset a large portion of projected load growth

Projected Utility Customer Funding for Electric and Gas EE Programs



Projected Incremental Annual Electric EE Savings from Customer-Funded Programs

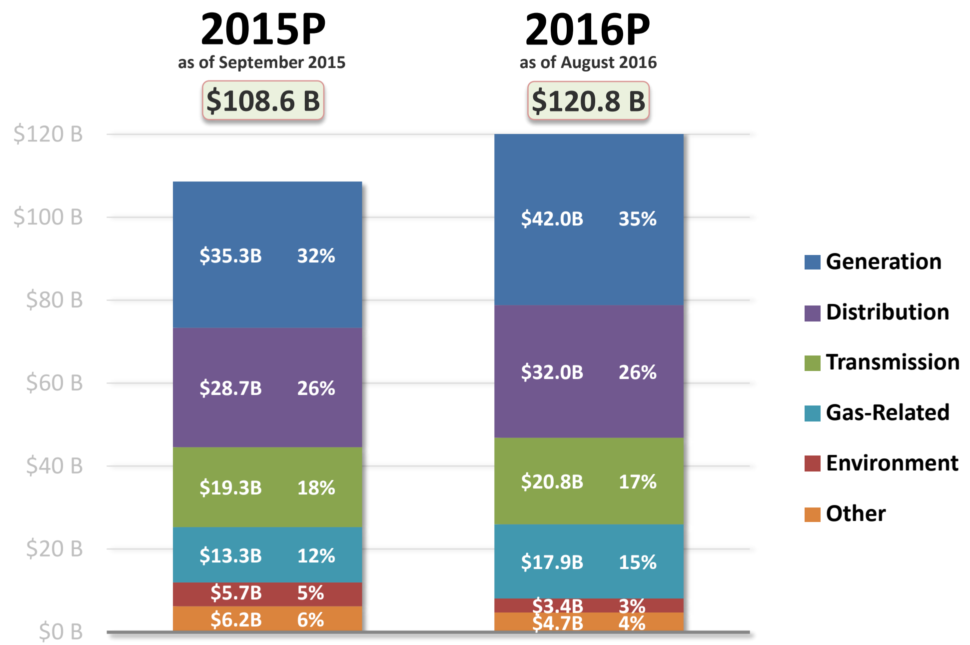
(% of Retail Sales)



- Total electric & gas utility spending on energy efficiency doubles to $9.5B in 2025 (medium case)
  Projected annual incremental savings rise to 0.76% per year by 2025
- **Projected EE savings would offset much of electric load growth forecasted by EIA (medium case)**

Source: G. Barbose, et al. (2013) "The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025." LBNL Report No. 5803E

Changing demands driving increased electric utility capital investments

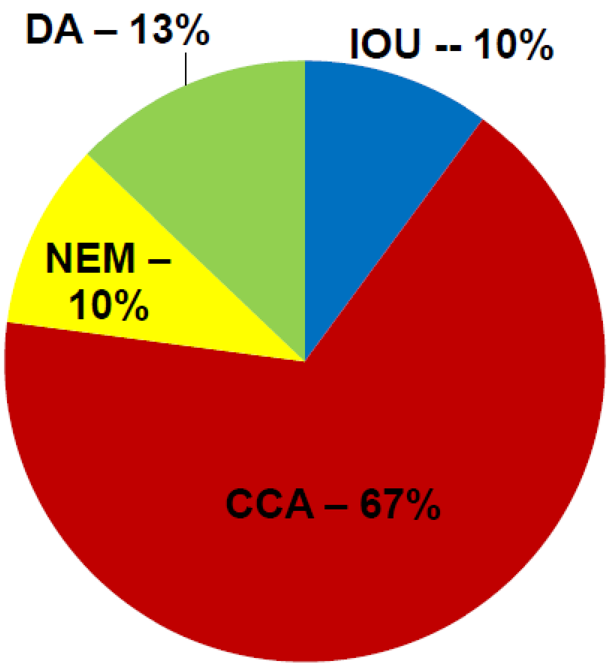


Notes: Total company functional spending of U.S. Investor-Owned Electric Utilities. 2015P total does not sum to 100% due to rounding. Projections based on publicly available information and extrapolated for companies not reporting functional detail (1.3% and 0.7% of the industry for 2015 and 2016, respectively).

Source: EEI Finance Department, company reports , S&P Global Market Intelligence (August 2016).

- Electric utilities are expecting to invest about $100B per year over the next three years to upgrade and modernize the electric system
- 2016 projected spending of $120B is double the electric industry's CapEx in 2006

Rise of community choice aggregators may drive departing load

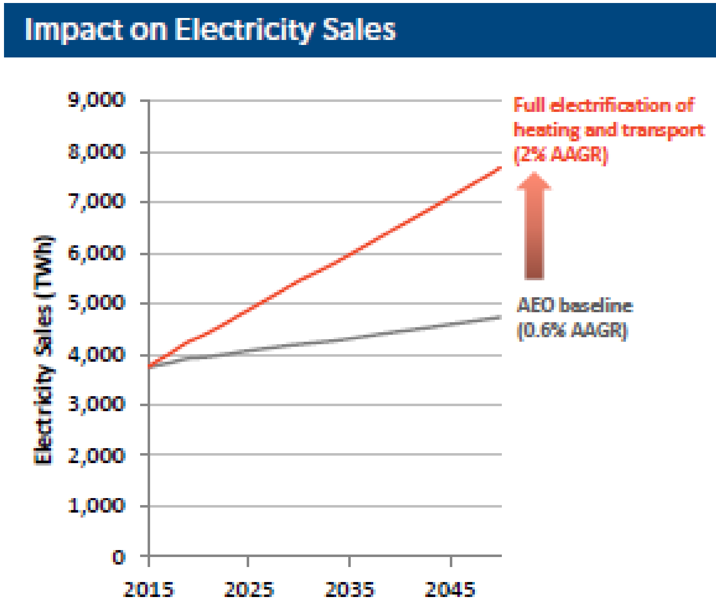


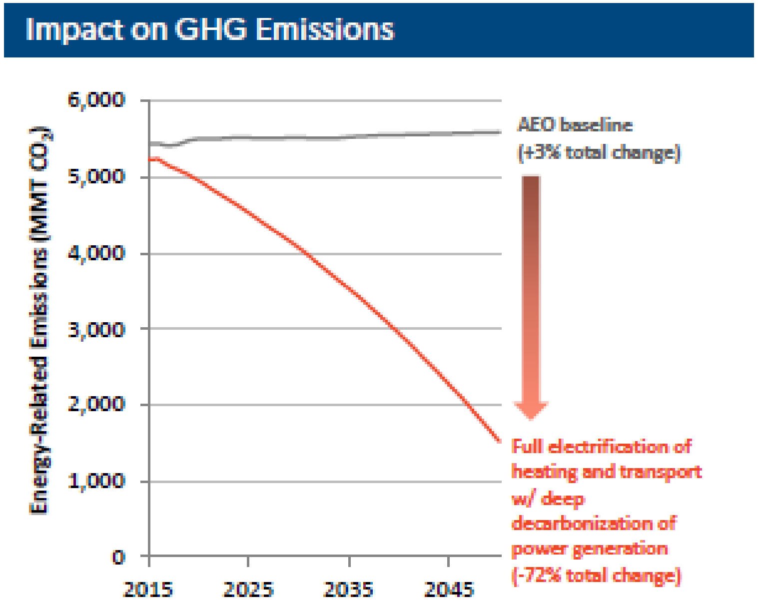
2020: future of retail market?

- Community choice aggregators (CCAs) allow local governments to aggregate customer loads and CCAs procure energy from suppliers other than utility
  - Seven states: CA, IL, MA, NJ, OH, NY, and RI
- CCA formation has been driven by desires for cleaner energy supply, local control, and customer choice
- May surpass net energy metering (NEM) customer enrollments – especially in California where CCAs are projected to comprise 67% of total load by 2020
- Significant concerns among utilities about departing load and stranded asset cost recovery

Source: CPUC President Michael Picker (2017) "Customer and Retail Choice in California." En Banc hearing presentation, May 19.

Electrification may provide substantial load building and investment opportunity for electric utilities



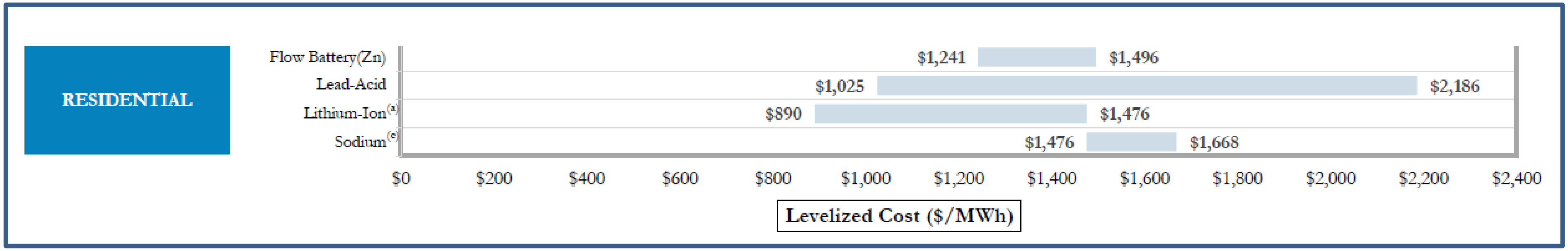


Source: The Brattle Group analysis based on EIA AEO 2015 data

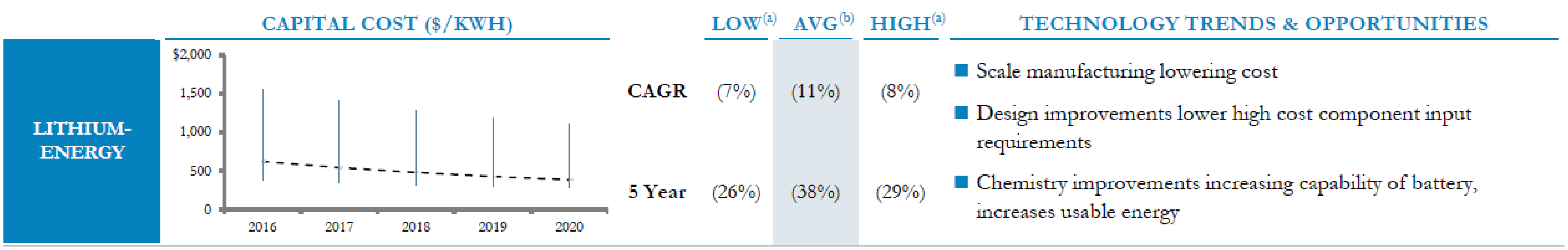
- Electrifying the transportation and heating sectors would more than double electricity demand from 2015 by 2050
- Electrification strategies may include opportunities for utilities to invest in charging infrastructure
- Yet, some regulators have been hesitant to allow direct competition between utilities and third-parties to build out the charging networks

Source: J. Weiss et al. (2017) "Electrification: Emerging Opportunities for Utility Growth." Brattle Group Report

Energy storage is not yet cost-competitive for residential customers



- Energy storage applications requiring longer duration of service (e.g., “grid defection”) is not economically attractive
- Select applications (e.g., frequency regulation, demand response) and for larger customers may be increasingly attractive as the cost of energy storage technologies are expected to decline (*see bottom figure*)



Source: Lazard (2016) “Levelized Cost of Storage: Version 2.0.”

Concerns among policymakers, utilities, and customers

Overview of "traditional" Cost-of-Service (COS) regulation

- Ratesetting objectives
  - Stable revenue (utility)
  - Efficient use of energy (customer) and capital (utility)
  - Fair, equitable and understandable rates (customer)

Ratemaking process – General rate case

Determination of revenue requirement → Allocation of costs to rate classes → Rates established based on allocation of costs and test year billing determinants (energy, demand, number of customers)

Utility financial incentives under "traditional" COS regulatory models

- A utility that can:
  - Keep growth in these other cost elements below revenue growth will see profits in excess of authorized levels
  - Promote growth in sales in excess of cost growth will likewise see profits in excess of authorized levels
- Any reduction in revenues, without corresponding reductions in costs, lowers utility profits

Electric utilities may face future of declining revenues and increasing costs threatening their business model

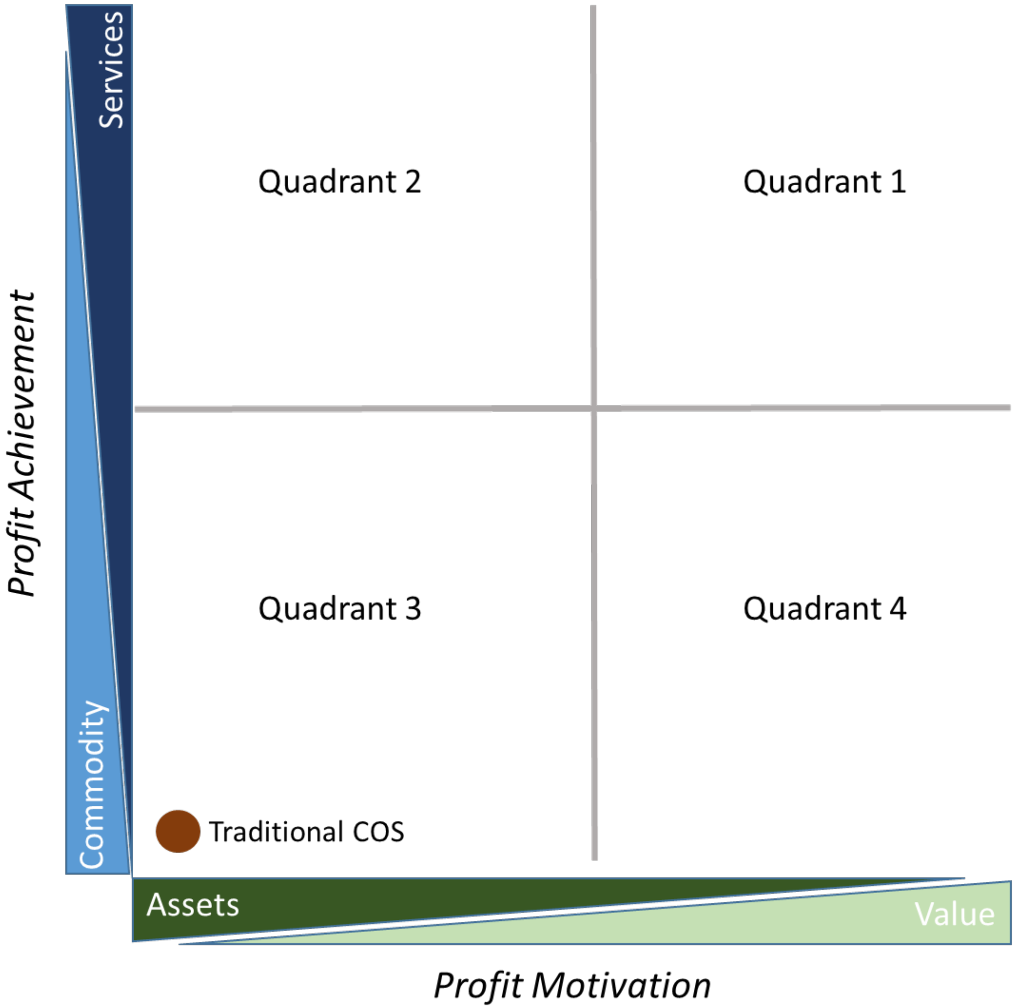
Revenues

Drivers include DER technology cost reductions, enabling policies for EE, and increased competition for services

Drivers include large capital investments to replace and modernize infrastructure, costs to accommodate high penetrations of DERs on the distribution system, and costs to enhance cybersecurity

Costs

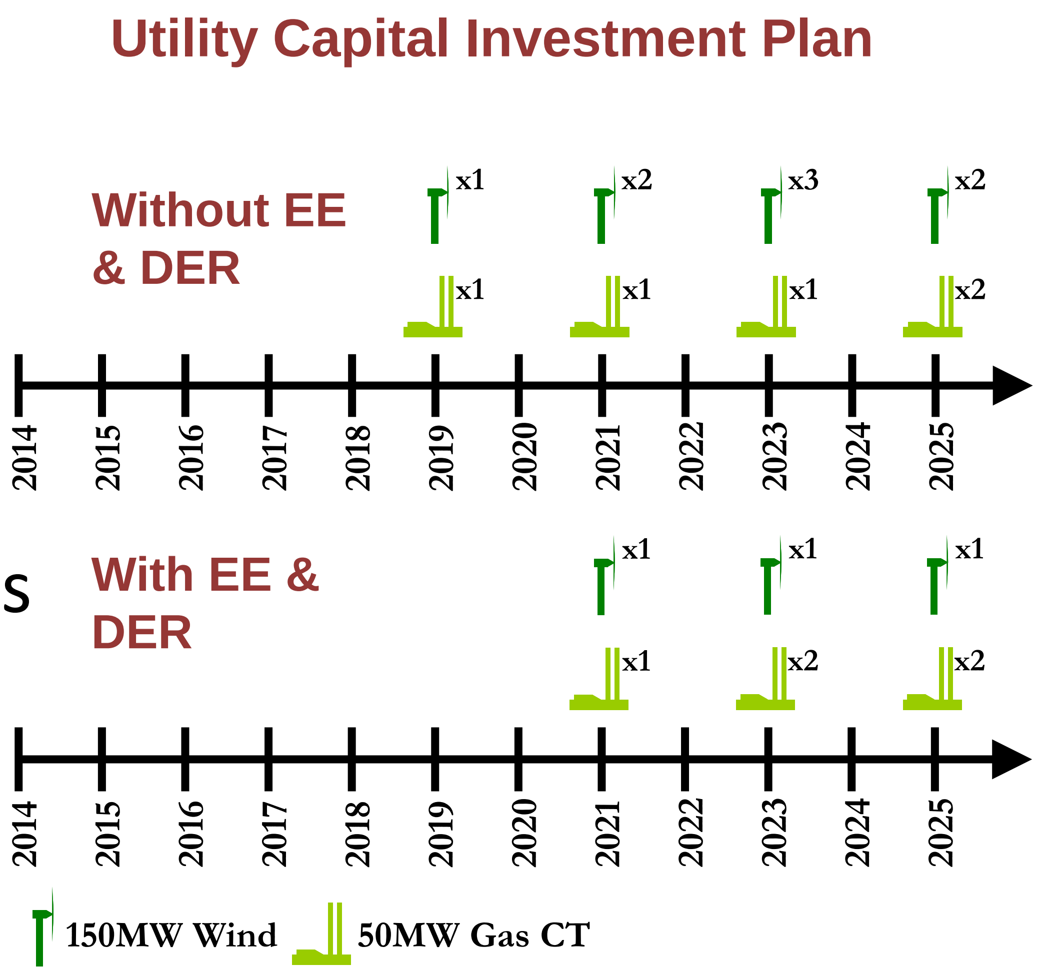
Conceptual framework for electric utility regulatory and business models



Source: A. Satchwell et al. (2015) “A Framework for Organizing Current and Future Electric Utility Regulatory and Business Models.” LBNL Report No. 181246

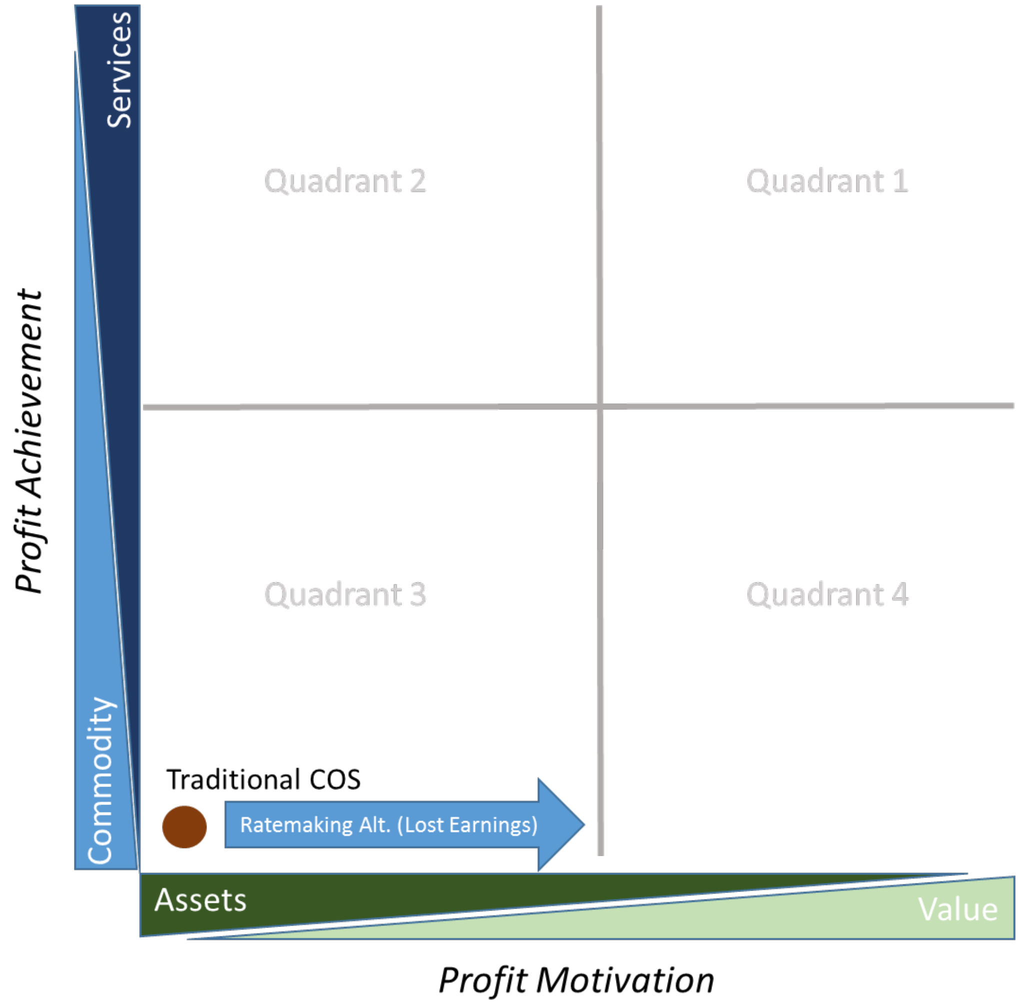
"Lost earnings opportunity" effect

- Lower commodity sales and peak demand from EE & DER results in deferral of GT&D investments
- Foregone capital investments represents lost earnings opportunity for the utility



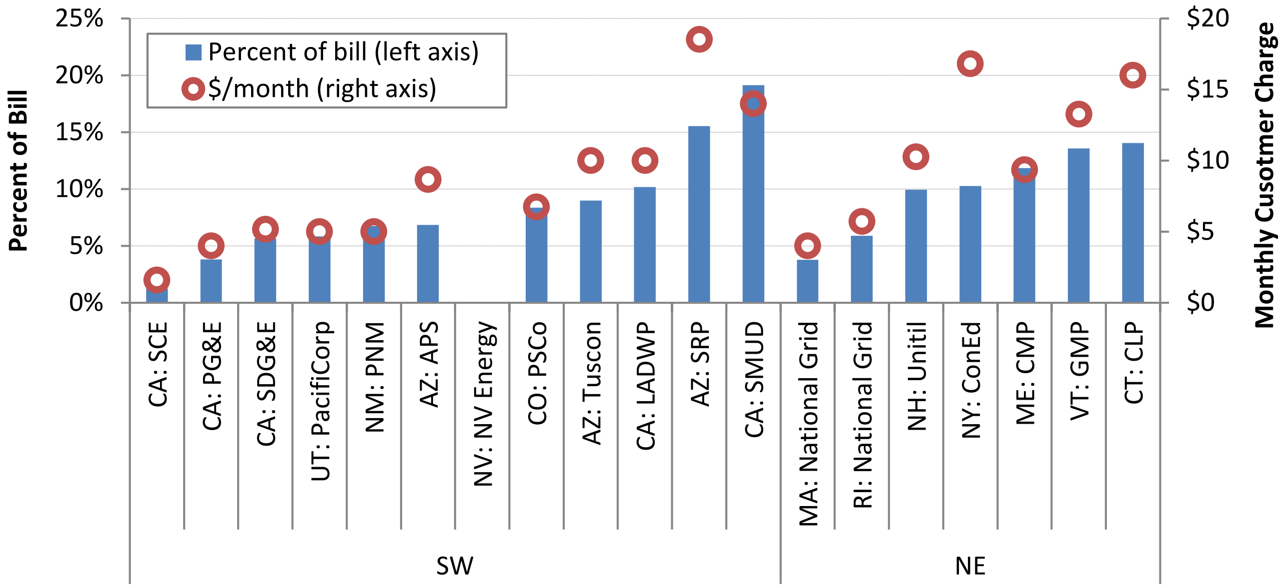
Mitigating the "lost earnings opportunity" effect
Focus on increasing value of assets

- **Shared Savings**– % of net benefits or avoided costs
- **Cost bonus** – % of expenditures for meeting goals
- **Cost capitalization** – Ratebase program expenditures and/or asset investment costs



"Revenue erosion" effect

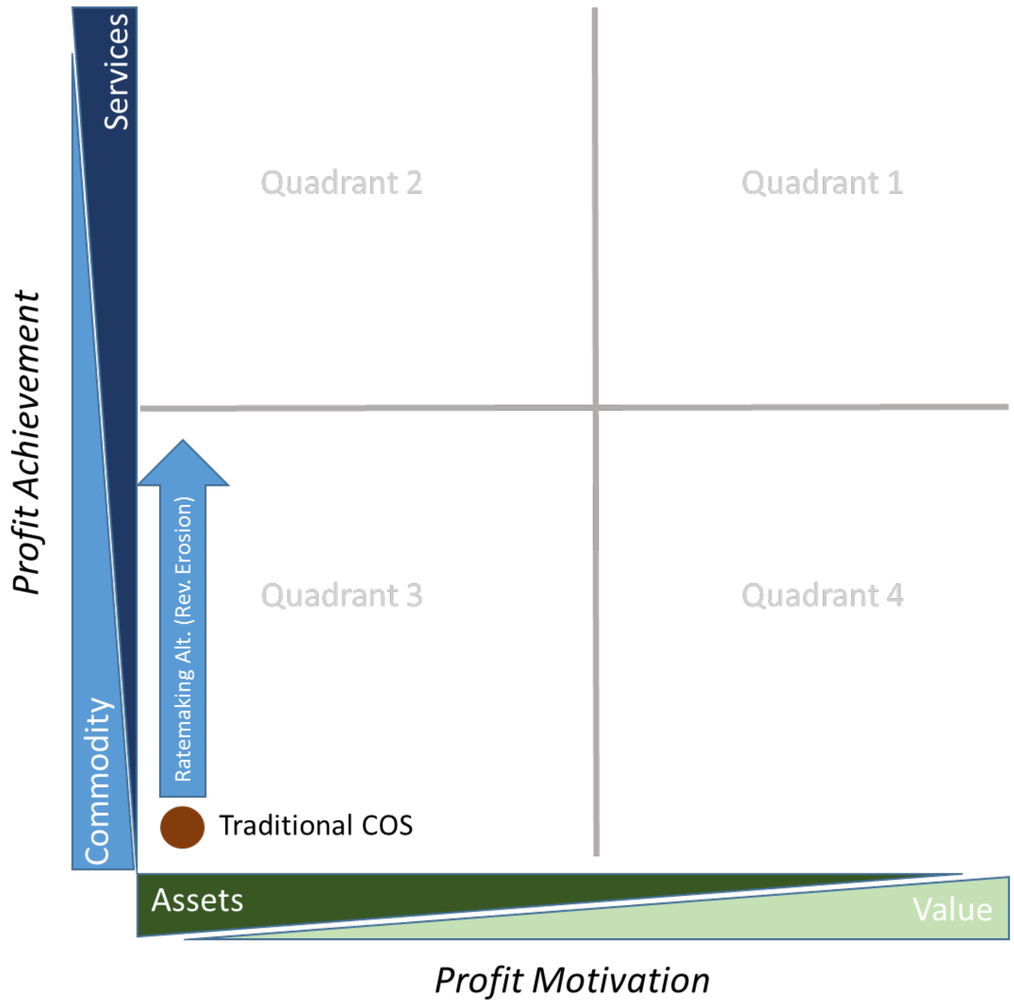
- Revenue collection largely driven by volumetric sales as residential rates include very modest fixed charges



- Lower sales from EE & DER results in lower collected revenues between rate cases

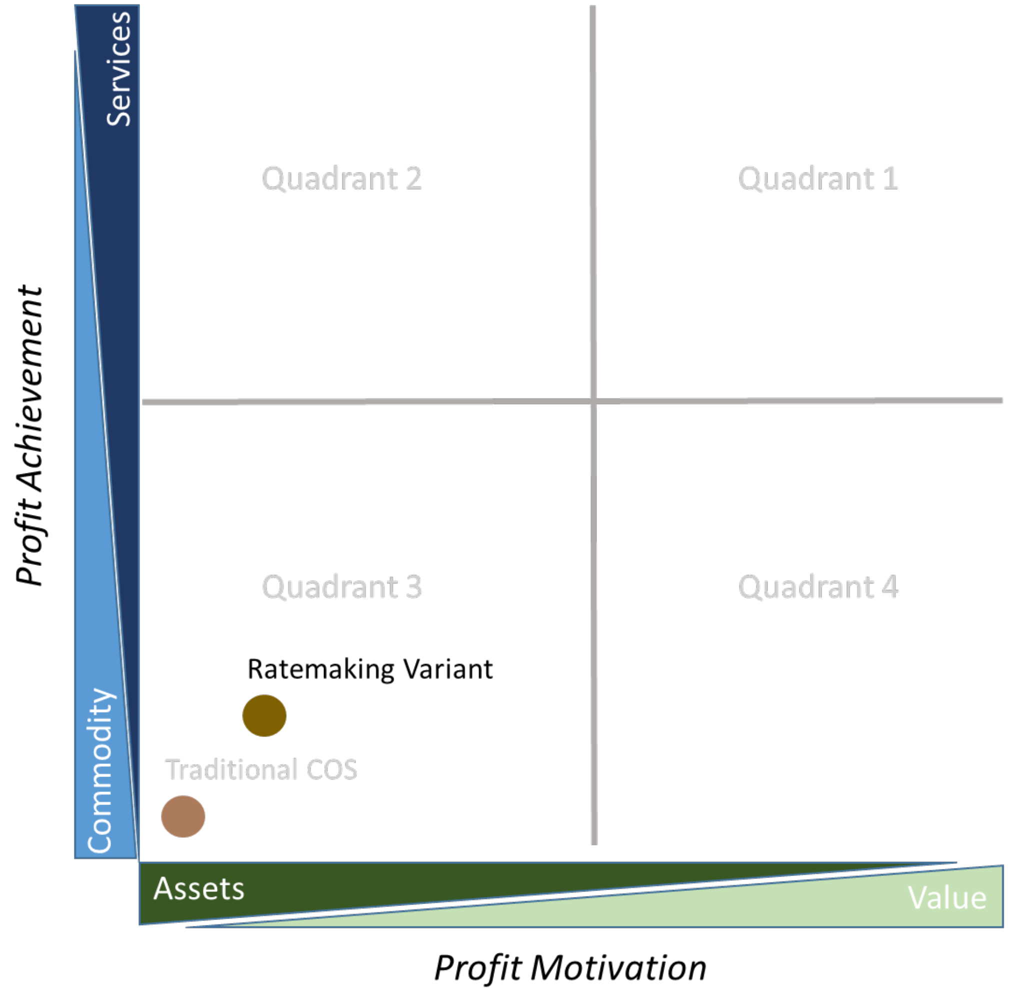
Mitigating the “revenue erosion” effect
Focus on revenue from electricity services

- **Rate design** – Higher fixed charges or higher demand charges for electric commodity service
- **Lost revenue mechanism** – Provide utility opportunity to recover “lost revenues” due to lower sales because of EE & DER
- **Decoupling** – Break link between commodity sales level and collected revenue



Incremental application of mitigation measures under traditional COS regulation

- Current application of COS regulation is not “pure”
- Includes modest movements along both axes
- Profit motivation still based more on assets than value
- Profit achievement still based more on sales than services



LBNL scoping study on financial impacts of customer-sited PV on utilities and ratepayers

Impacts of Net-Metered PV Study: Project Scope and Objectives

- Scoping analysis of two prototypical investor-owned utilities:
  - characterize the scale of potential financial impacts of distributed solar on utility shareholders and customers
  - identify and explore key **sensitivities** and potential **mitigation** strategies
- Leverages LBNL pro-forma financial model of utility costs and revenues
  - Three metrics: changes in (1) achieved earnings, (2) return-on-equity, and (3) average retail rates
- Objectives
  - Help to frame, organize and inform ongoing discussions among policymakers, utilities, and stakeholders

Impacts of Net-metered PV Study: Structure of the analysis

Two “prototypical” investor-owned utilities

- Southwestern vertically integrated utility
- Northeastern wires-only utility and default service provider

Analytical elements

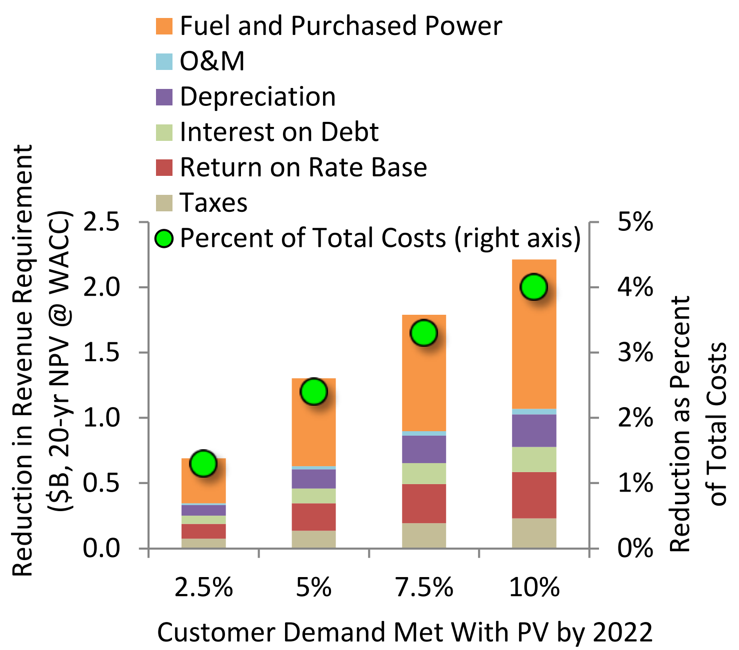
- **Base case**: A reference point against which sensitivities and mitigation measures can be measured
- **Sensitivity cases**: How do the impacts of PV depend on the utility operating and regulatory environment?
- **Mitigation cases**: To what extent can the impacts of PV be mitigated through regulatory and ratemaking measures?

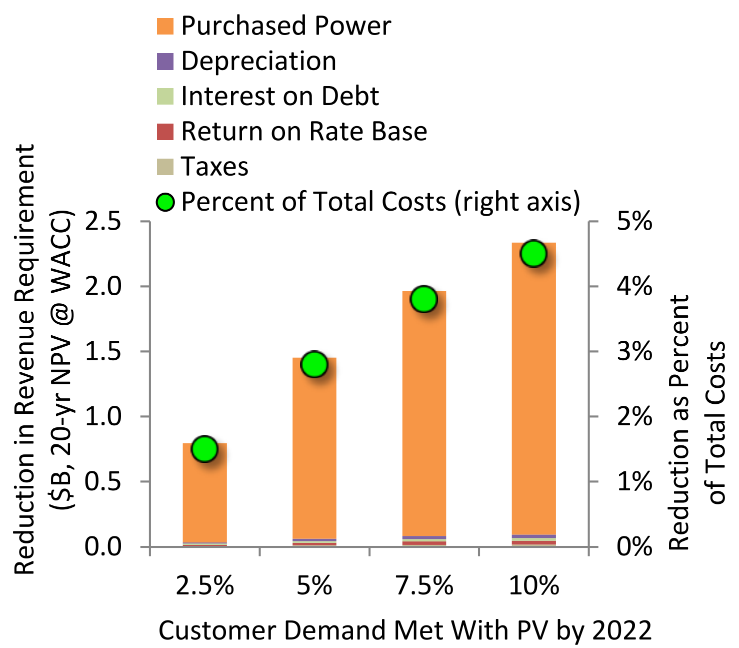
Key parameters of the analysis

- Distributed PV ramps up over 10 years, but utility costs and revenues modeled over 20 years to capture end-effects
- Consider range of PV penetration (2.5% to 10% of retail sales) in Base Case, while Sensitivity and Mitigation cases focus on 10% trajectory

Modeled utility cost reductions from PV

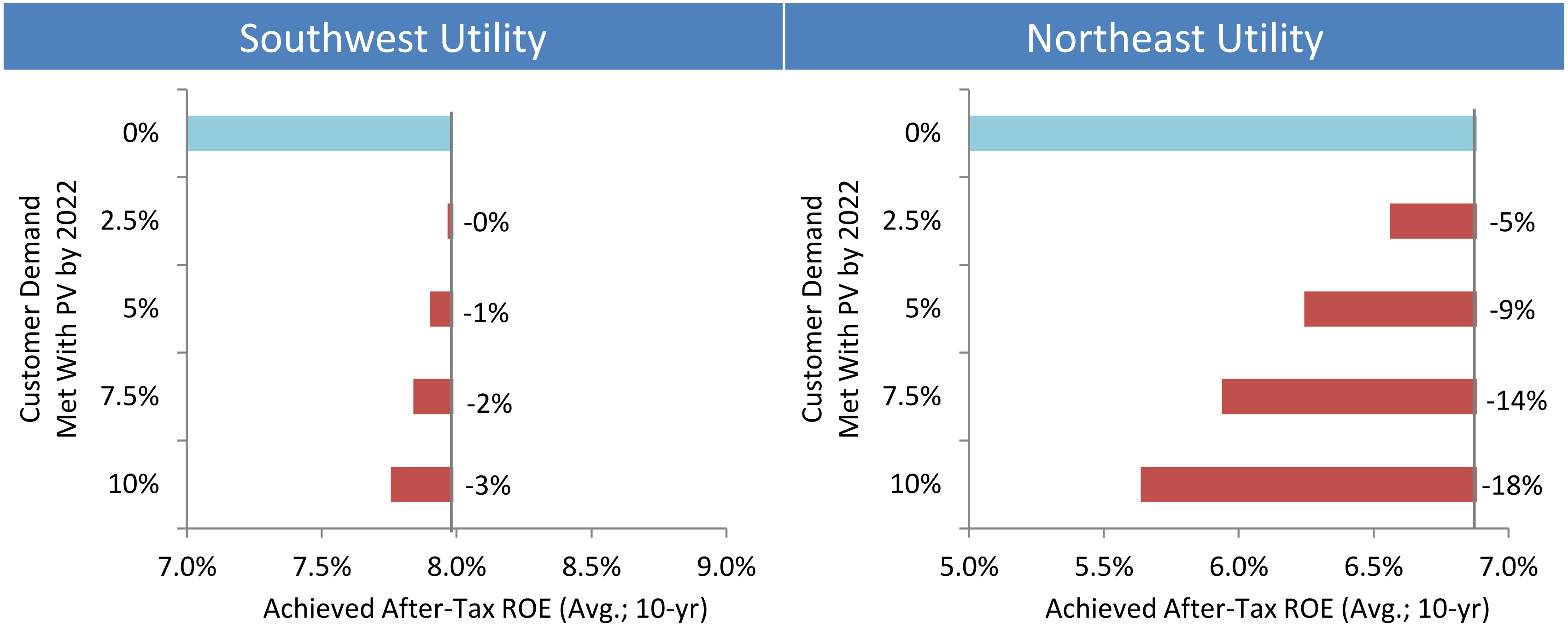
Southwest Utility	Northeast Utility





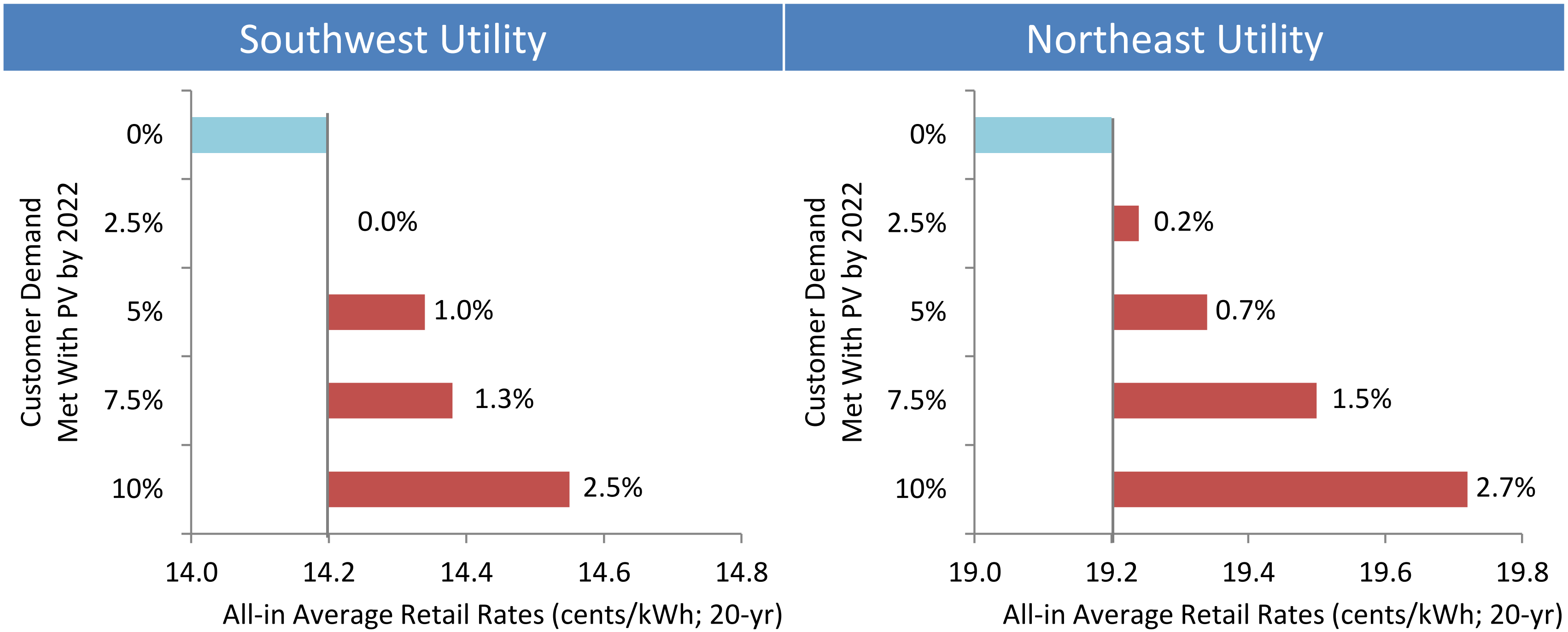
- Differences in composition of cost reductions between utilities are due to their differing cost structures: SW Utility owns generation while NE Utility procures all generation requirements via purchased power
- Assumptions related to deferral of generation and T&D investments, and to fuel and purchased power costs, are explored in sensitivity analysis

Under base-case assumptions, PV reduces achieved ROE



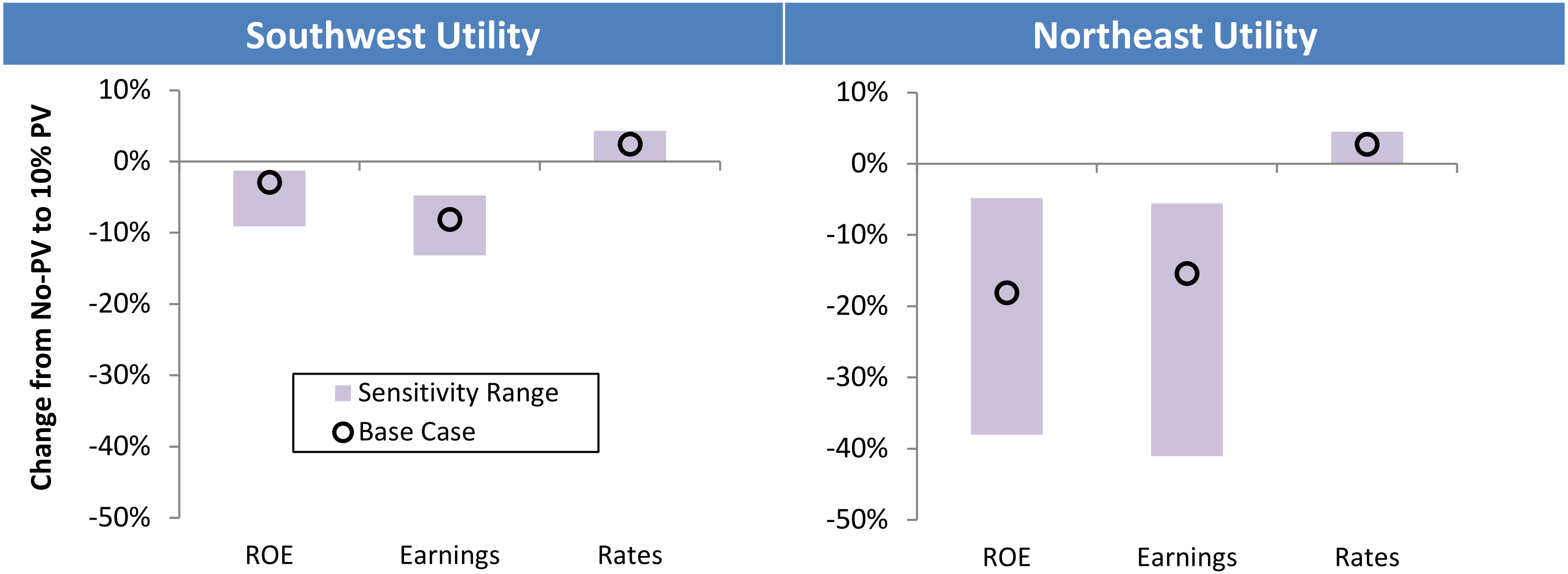
- Customer-sited PV reduces revenues by a greater amount than it reduces costs, leading to reduction in ROE ("revenue erosion effect")
- Impacts are larger for the NE utility, because of its higher assumed growth in fixed costs and its proportionally smaller rate base

Average customer rates increase slightly under base case assumptions



- Under base case assumptions, PV reduces sales and peak demand by a greater amount than it reduces costs, which causes average retail rates to increase
- Note, though, that these estimated rate impacts represent average impacts across all customers, thus do not directly measure cost shifting between PV and non-PV customers or for any individual customer class

Impacts depend on utility-specific conditions



**All sensitivity cases focus on impacts under 10% PV trajectory for illustrative purposes*

- Impacts are directionally consistent, but their magnitude varies widely
- Shareholder impacts (ROE and earnings) are particularly sensitive to utility operating and regulatory environment, especially for NE Utility
- Greatest sources of sensitivity vary by metric and utility: for NE utility, choice of test year and load growth causes large swings in shareholder impacts, but value of PV is key for ratepayer impacts

Mitigation analysis overview

Objective: Explore the efficacy and potential tradeoffs associated with regulatory and ratemaking measures for mitigating the impacts of PV

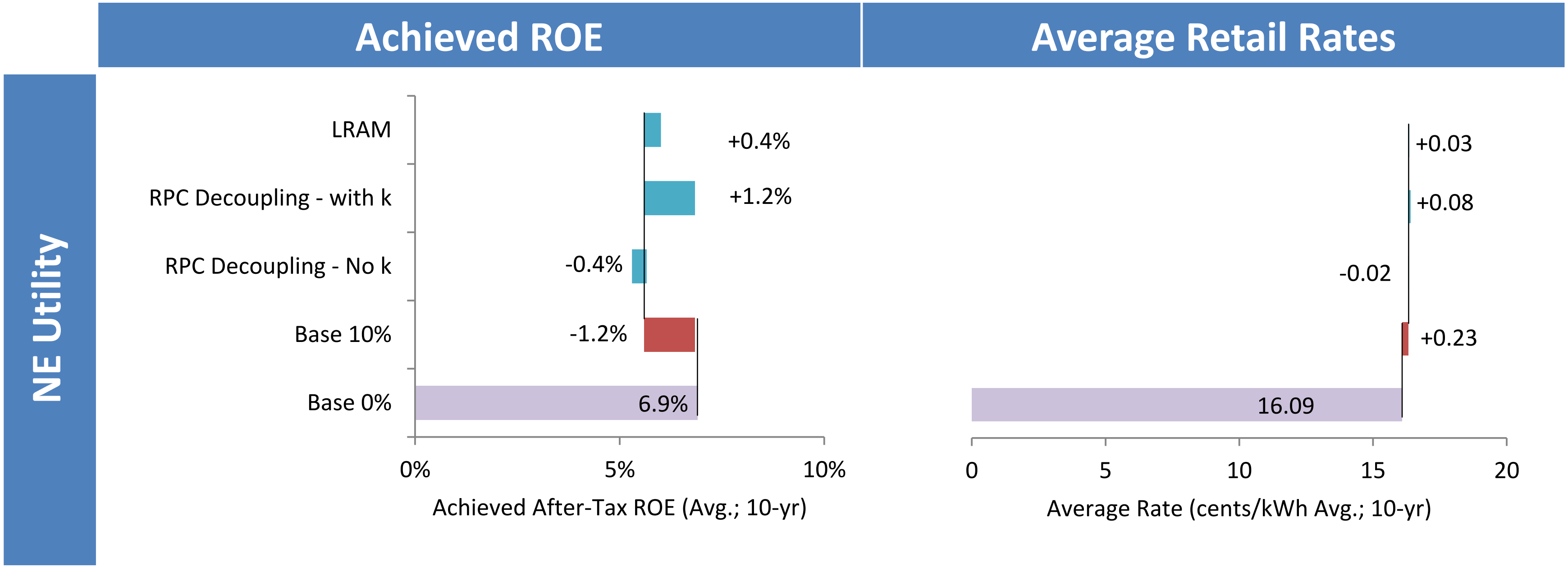
Mitigation Measure	Revenue Erosion	Lost Earnings Opportunities	Increased Rates
Revenue-per-Customer (RPC) Decoupling	●		○
Lost Revenue Adjustment Mechanism (LRAM)	●		○
Shareholder Incentive		●	○
Shorter Rate Case Filing Frequency	●		○
No Regulatory Lag	●		○
Current & Future Test Years	●		○
Increased Demand Charge & Fixed Charge	●		○
Utility Ownership of Customer-Sited PV		●	○
Customer-Sited PV Counted toward RPS			●

Example results

● Primary intended target of mitigation measure
○ May exacerbate impacts of customer-sited PV

- Mitigation scenarios borrow from measures implemented with energy efficiency programs, though are not an exhaustive set of options
- Mitigation analysis focuses on impacts under 10% PV trajectory, for illustrative purposes

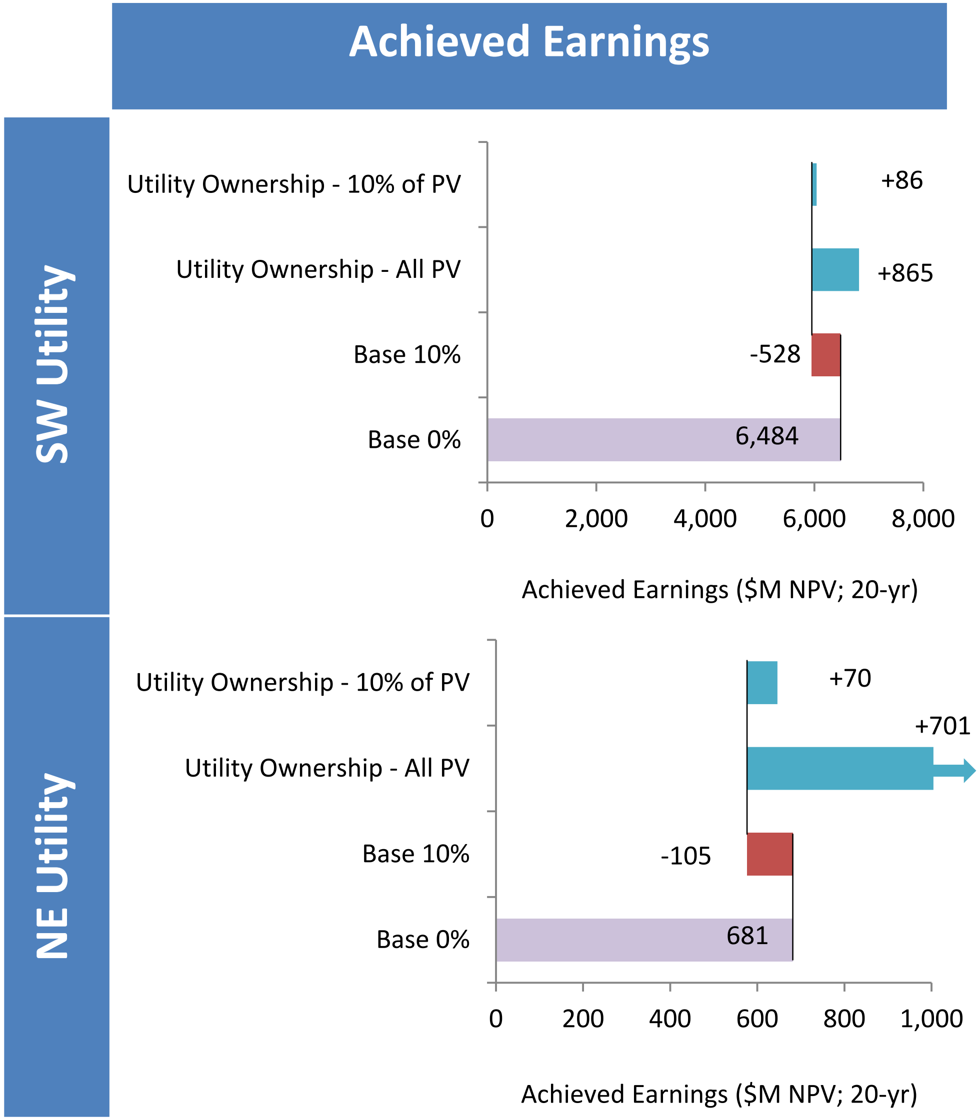
Decoupling and LRAM mitigate revenue erosion effect



- RPC decoupling and LRAM mitigate revenue erosion impacts from customer-sited PV, thereby improving ROE, but degree of mitigation varies by utility and depends on design (e.g., k-factor)
- Mitigation of shareholder impacts in these cases necessarily entails an increase in average retail rates, illustrating one form of tradeoff

Utility ownership of PV may provide substantial earnings opportunities offsetting the impacts

- Utility ownership and capitalization of customer-sited PV provides increased earnings, offsetting most or all the financial impacts to shareholders
- NE Utility could see substantial increases in earnings by investing in customer-sited PV
- Utility ownership or financing of customer-sited PV may raise significant policy and/or regulatory issues around risk sharing, competition, and generation asset ownership



5 Minute Break

What fundamental changes to regulatory approaches and utility business models are being considered?

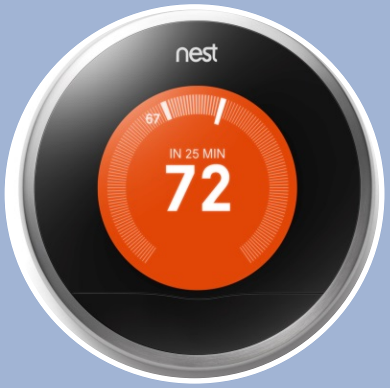
Incremental changes to existing utility business model: Are they sufficient and sustainable?

Shareholder incentives

Lost fixed cost recovery

Rate base PV investments

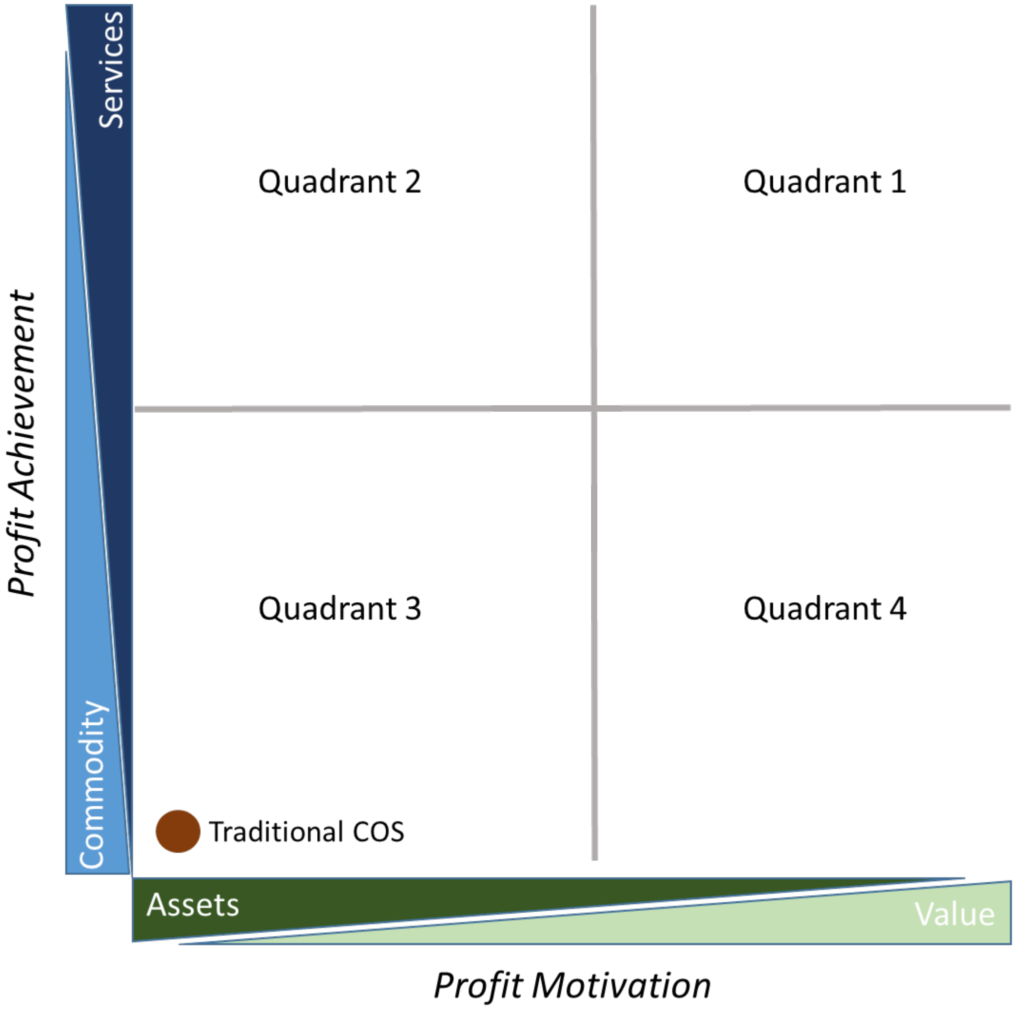
Retail rate design changes



Profit from wholesale off-system sales

Profit from selling energy services and customer technologies

Conceptual framework for electric utility regulatory and business models



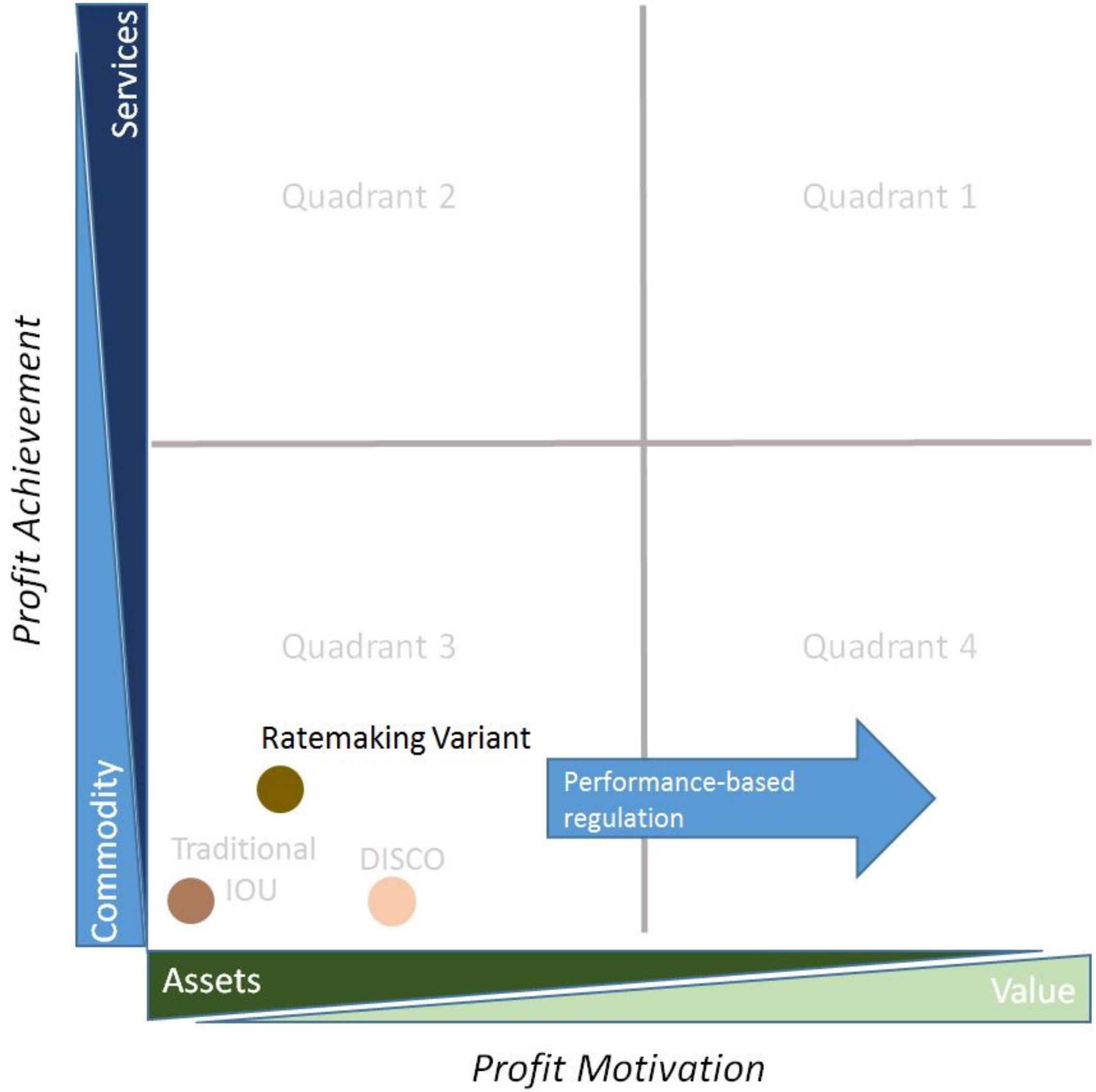
Source: A. Satchwell et al. (2015) "A Framework for Organizing Current and Future Electric Utility Regulatory and Business Models." LBNL Report No. 181246

Regulatory paradigms and utility business models depend upon…

Profit Motivation	Assets	Value
Profit Achievement	Commodity Sales	Services
Market structure/Scope of asset ownership	Vertical integration	Retail competition
Role of utility in providing value-added services	Utility provides value-added services	Utility does **not** provide value added services
Degree to which utility networks are “open” and “accessible” to third parties	“Open” and “accessible”	“Closed” and “inaccessible
Risk to utility shareholders, customers and non-utility service providers	Less risk	More risk

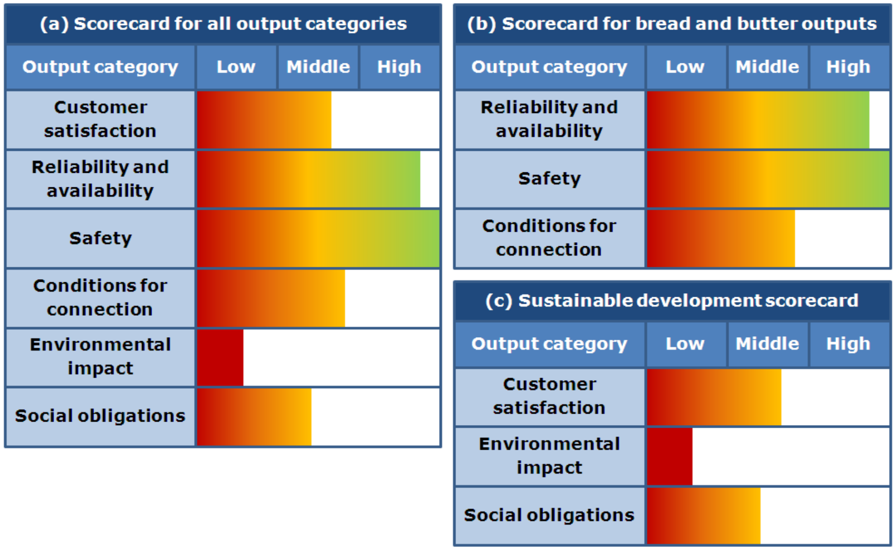
Creating a value-driven utility

- Performance-based regulation ties utility revenues to performance relative to goals
- Limited experience in the U.S. with comprehensive PBR approaches



Creating a value-driven utility
Example: Great Britain's RIIO model

- Revenue = Incentives + Innovation + Outputs
- Objectives include:
  - Addressing challenges of large future investment costs
  - Maintaining reliable and secure delivery networks
  - Meeting environmental objectives
  - Incentivizing investments in innovation projects, and enabling them through a separate fund

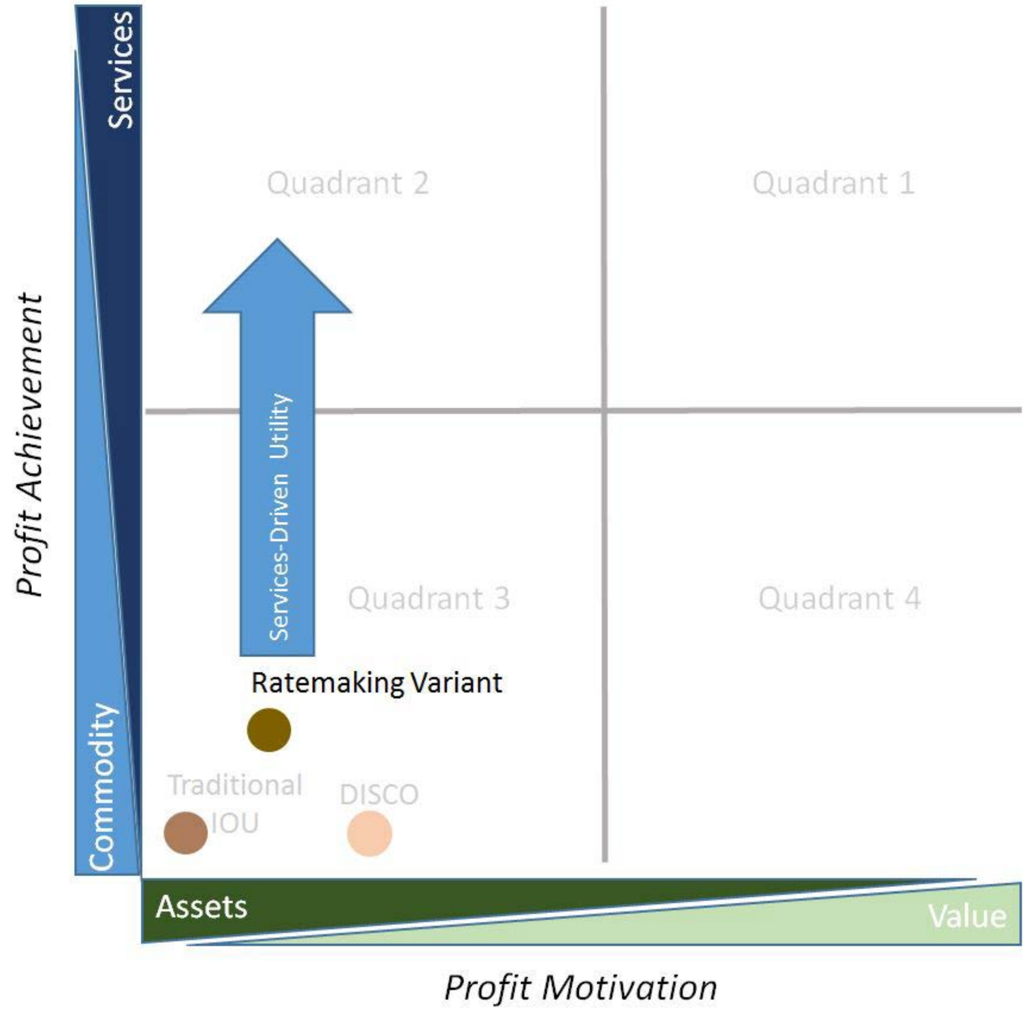


- Utility business plan includes outputs and deliverables and 8 year forecast of costs and revenues
- Revenue is capped and adjustment mechanisms are agreed to
- Significant role of the regulator
  - Regulator sets primary outputs and baseline performance, reviews and approves business plans, performs inspections, and decides on incentives and penalties; may revoke distribution network operator (DNO) license to operate

- Does not necessarily suggest change in utility roles
- Different financial risks for utility
  - Profits are contingent on meeting goals and not necessarily levels of costs and sales between rate cases
- Limited experience in the U.S. with comprehensive PBR approaches
  - Some experience with "targeted PBR" focused on particular areas of utility performance (e.g., successful achievement of energy savings goals)

Creating a services-driven utility

- Utility provides or enables value-added services (e.g., EE, PV, DR, storage, home automation)
- Services priced to collect sufficient revenue to cover fixed costs (incl. returns)
- Profit achievement focused more on services enabled or delivered by utility and/or third parties than commodity sales



Creating a services-driven utility

Example 1: Distribution system operator

- A distribution system operator (DSO) could manage the distribution network to integrate DERs and facilitate transactions between third-party service providers, utilities, and customers
- The incumbent utility or an independent entity could take on the DSO role

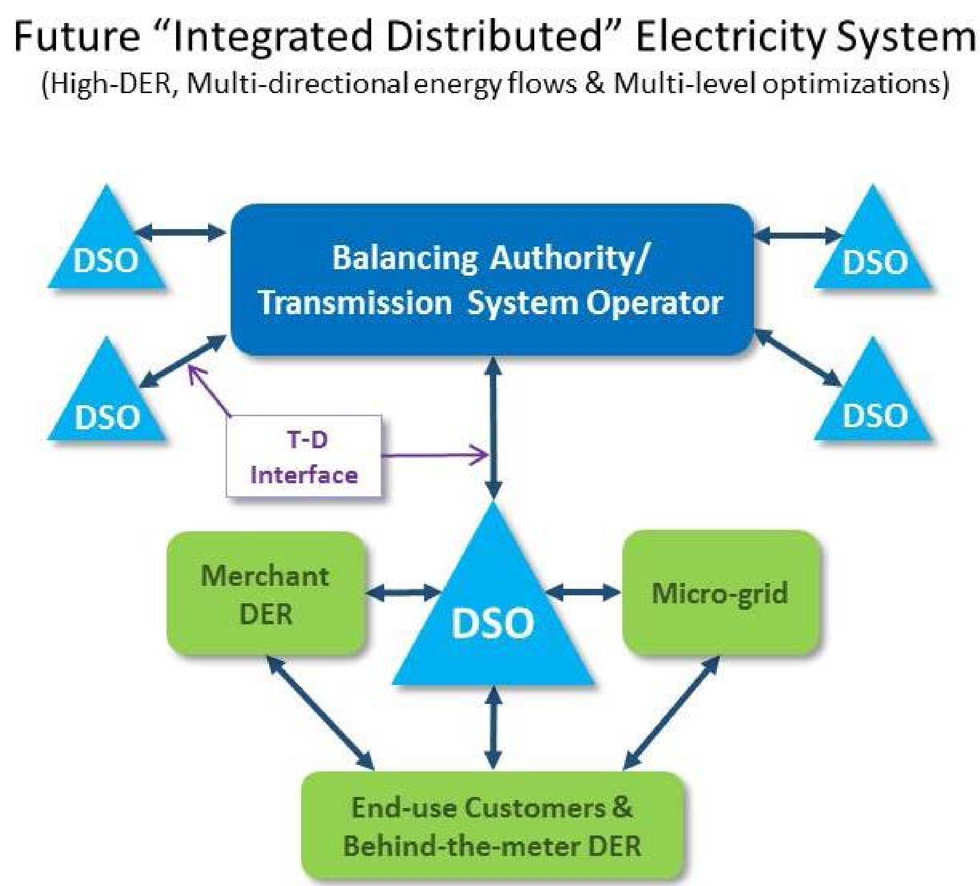
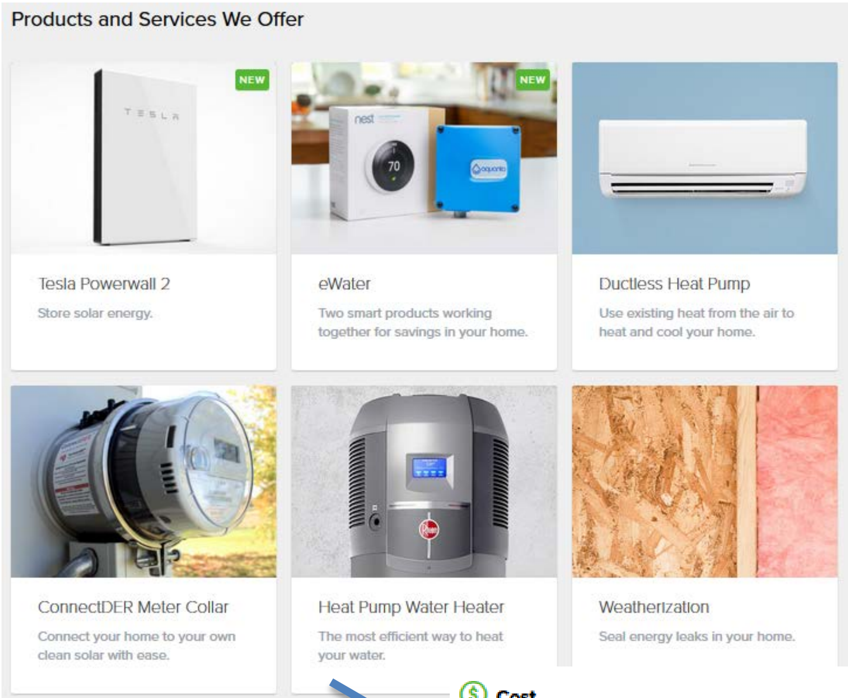


Figure: Kristov and DeMartini (2014). "21st Century Electric Distribution System Operations." Caltech Resnick Institute, May.

Creating a services-driven utility
Example 2: Green Mountain Power (Vermont)



Cost

Amount	$25.25 - $40.25/month
Monthly payments range from $25.25/month for the smallest unit to $40.25 for the largest	180 months
All other financing terms remain the same.	No down payment required.
	A 10.74% APR for the whole term of the agreement.
Annual Operating Cost	Daily Operating Cost
$270 (for family of 2)	$0.74

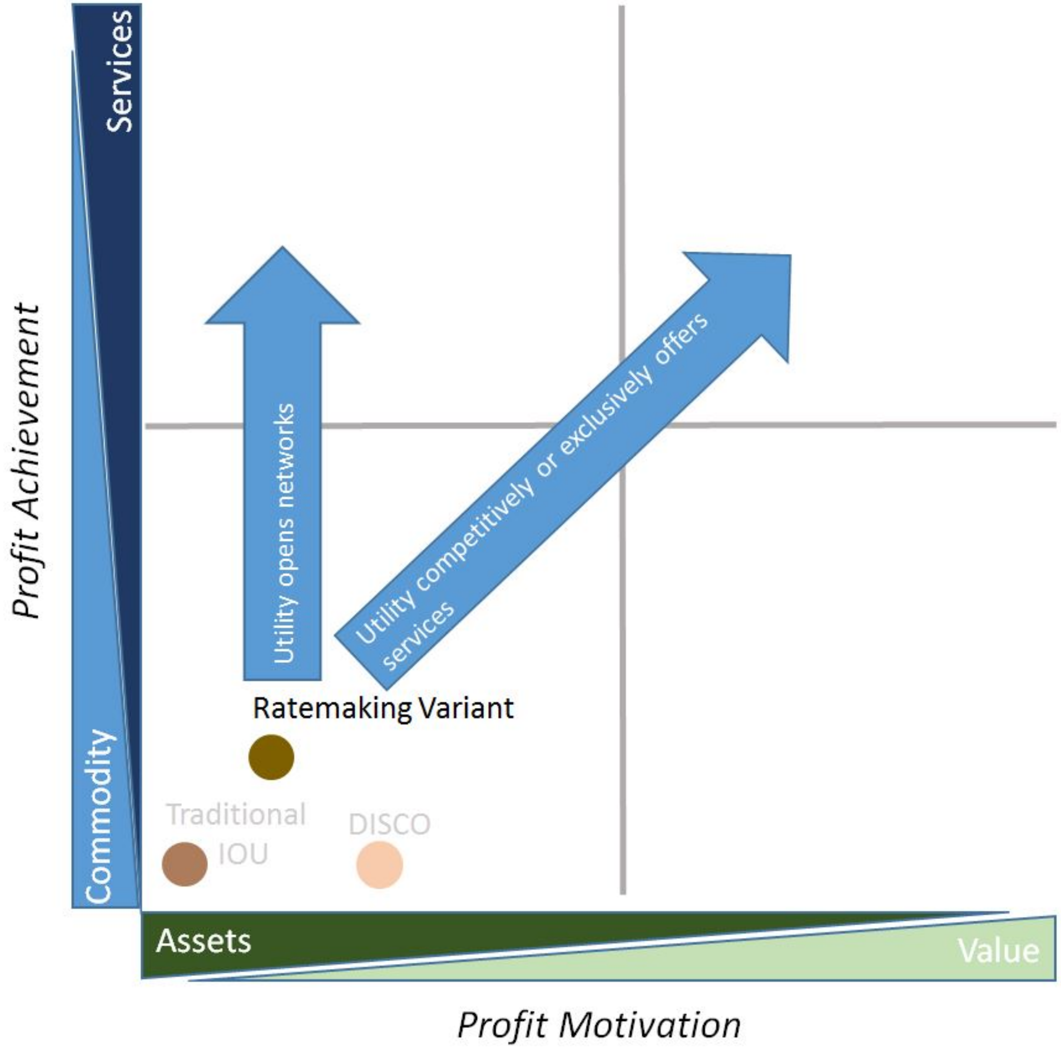
- Green Mountain Power offers a range of products to customers through monthly leasing payments
- Recent innovations include an "off-grid package" where customers pay a monthly fee for the utility provided efficiency upgrades, solar, and battery systems in remotely served locations
- Some leased technologies are utility-controlled to take advantage of load shedding and storage capabilities

Creating a Services-Driven Utility
Regulatory and Policy Implications

- Role of utility would potentially change
  - Regulators and policymakers will need to consider impacts on competitive markets
  - Utility may need to grant access to customer information and utility networks
- Utilities and customers would face new risks
- Changes in pricing – especially for energy services
  - Properly attributing costs to specific energy services

Creating a services- and value- driven utility

- Fundamental and comprehensive change where profit achievement based more on services than commodity and profit motivation based more on value than assets
- Approach may result in complete paradigm shift in the way utilities are rate regulated



New York 'Reforming the Energy Vision'

- New York's long-term energy modernization strategy
  - Initiated by Governor Cuomo and is now a NY Public Service Commission (PSC) proceeding (case 14-M-0101)

Track I

- Long-term goals and expectations for transforming utility service and electricity markets
- Extends energy efficiency and renewable energy spending and targets
- Envisions retail system operator – Distribution System Platform

Track II

- Clarifies regulatory approaches to fundamentally change the way utilities are motivated to meet clean energy public policy goals
- Financial and nonfinancial scorecards
- Track progress and motivate utilities to meet goals
- Earnings sharing mechanisms
- New DER compensation mechanisms and shift towards time-based pricing

NYREV creates new utility revenue generating opportunities

Platform Service Revenue (PSR)	Earnings Adjustment Mechanism (EAM)
New forms of utility revenues associated with operation and facilitation of distribution-level value-added services markets	***Direct incentives linked to specific outcomes that align utility financial interests with Commission REV outcomes***
Revenues must be shared between ratepayers and shareholders	Positive, negative or bi-directional EAMs structured on a multi-year basis
Distinguish between three types of products and services - 1st two eligible for PSRs	Three EAMs specifically identified with fourth to be considered in the future
Type 1: Required by utility to provide as part of market development	**System efficiency**: Peak reduction and load factor improvement targets
Type 2: Voluntary value-added services provided through DSP function	**Energy efficiency**: Electric usage intensity targets, program-specific savings
Type 3: Competitive new services exclusively provided by 3rd parties	**Customer engagement**: Specific to success of specific utility program
	Interconnection: Timeliness of review and satisfaction with review process

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Type 1: Required by utility to provide as part of market development	**System efficiency**: Peak reduction and load factor improvement targets
Type 2: Voluntary value-added services provided through DSP function	**Energy efficiency**: Electric usage intensity targets; program-specific savings
Type 3: Competitive new services exclusively provided by 3rd parties	**Customer engagement**: Specific to success of specific utility program
	Interconnection: Timeliness of review and satisfaction with review process

New York utility EAM filings offer different specifics on metrics and earnings potential

- Metric assessment based on surveys, audits, and measured energy savings
- EAM metrics differ among utilities – e.g., coincident vs. non-coincident peak load reduction, type of qualifying DER, interconnections of incremental vs. total DER

ConEdison EAM (C. 16-E-0060)		
EAM	**Metric(s)**	**Possible earnings (first year)**
Peak Reduction/ System Efficiency	Peak Reduction	\$0.29M (0.2 bp) min, \$1.15M (0.75 bp) target, \$3.46M (2.25 bp) max
	DER Utilization	\$0.60M (0.4 bp) min, \$1.11M (0.7 bp) target, \$2.72M (1.75 bp) max
Energy Efficiency	Incremental GWh Savings	\$0.58M (0.4 bp) min, \$4.03M (2.6 bp) target, \$9.22M (6.0 bp) max
	Energy Intensity - Residential	\$0.11M (0.07 bp) min, \$0.39M (0.25 bp) target, \$0.95M (0.62 bp) max
	Energy Intensity - Commercial	\$0.20M (0.13 bp) min, \$0.72M (0.47 bp) target, \$1.76M (1.14 bp) max
Customer Engagement and Information Access	Customer Awareness	\$0.20M (0.13 bp) min, \$0.72M (0.47 bp) target, \$1.76M (1.14 bp) max
Interconnection	No EAM in first year	
	TOTAL	**\$1.98M (1.3 bp) min, \$8.12M (5.2 bp) target, \$19.87M (12.9 bp) max**

Concluding thoughts

Transitioning to New Utility Business Models

- States will consider new regulatory framework and business models at their own pace; expect diverse approaches and watch the early movers
- Effective transition strategies can mitigate risk
- Transition strategies should address the following:

  - Market structure
  - Asset ownership
  - Planning/Operation responsibility
  - Utility role in providing services
  - Openness of utility networks
  - Data privacy and sharing
  - Regulatory process
  - Leverage experience
  - Incremental changes to COS regulation
  - Assessing and ensuring customer benefits

Utility regulation in 2030?

- Regulatory models likely to vary significantly among states
  - Utilities likely to pursue incremental strategies to mitigate "threats" to their business model & revenues (e.g., high customer charges, limit net metering) before proposing fundamental changes to regulatory compact
  - Likely to see more examples of incremental changes to cost-of-service regulation
  - Some states will explore more fundamental changes to utility regulation
- Appropriate roles for Legislatures vs. state commissions in electric power sector?
  - Articulating balance among public policy goals for electric sector (e.g. universal, reliable, and affordable service, customer choice, and environmentally sustainable)
  - Facilitate technology and service innovation
  - Ask hard questions of your utilities

Questions/Comments

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Resources: LBNL Publications and Presentations

LBNL – EE Business Model Quantitative Financial Analysis

- Satchwell, A., P. Cappers, and C. Goldman (2011). "Carrots and Sticks: A Comprehensive Business Model for the Successful Achievement of Energy Efficiency Resource Standards." Utilities Policy; Volume 19, Number 4 (218-225).
- Cappers, P., A. Satchwell, C. Goldman, and J. Schlegel (2010). "Benefits and Costs of Aggressive Energy Efficiency Programs and the Impacts of Alternative Sources of Funding: Case Study of Massachusetts." LBNL-3833E. August.
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- Cappers, P., C. Goldman, M. Chait, G. Edgar, J. Schlegel, and W. Shirley (2008). "Financial Analysis of Incentive Mechanisms to Promote Energy Efficiency: Case Study of a Prototypical Southwest Utility." LBNL-1598E. March.
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- Satchwell, A., P. Cappers, and C. Goldman (2017). "Financial Impacts of a Combined Energy Efficiency and Net-Metered PV Portfolio on a Prototypical Northeast Utility." April.
- Satchwell, A., A. Mills, G. Barbose, R. Wiser, P. Cappers, and N. Darghouth (2014). "Financial Impacts of Net-Metered PV on Utilities and Ratepayers: A Scoping Study of Two Prototypical U.S. Utilities." September.
- Mills, A. and R. Wiser. (2014) "Strategies for Mitigating the Reduction in Economic Value of Variable Generation with Increasing Penetration Levels." LBNL-6590E. March.
- Darghouth, N., G. Barbose, and R. Wiser (2013). "Electricity Bill Savings from Residential Photovoltaic Systems: Sensitivities to Changes in Future Electricity Market Conditions." LBNL-6017E. January.
- Darghouth, N., G. Barbose, and R. Wiser (2012). "The Potential Impact of Increased Renewable Energy Penetration Levels on Electricity Bill Savings From Residential Photovoltaic Systems." LBNL-6188E. November.

LBNL – Future Regulatory and Utility Business Models

Selected Presentations

- NGA Policy Academy on Power Sector Modernization. February 2, 2017. Managing the Financial Impacts of Distributed Energy Resources. San Diego, CA.
- California Municipal Utilities Association Annual Conference. April 2, 2014. Utility Business Models in a Low Load Growth/High DG Future. Napa, CA
- Legislative Energy Horizon Institute. October 24, 2013. State/Province Regulation in 2030: Gazing Into the Crystal Ball? Washington, D.C.
- NGA Policy Institute. September 11-12, 2013. Emerging Ideas to Modernize Utility Business Models. Denver, CO
- NARUC Summer Committee Meeting. July 23, 2013. Utility Business Models in a Low Load Growth/High DG Future. Denver, CO.
- WIEB Committee on Regional Electric Power Cooperation/State-Provincial Steering Committee Meeting. April 10, 2013. Utility Business Models in a Low Load Growth/High DG Future: Gazing Into the Crystal Ball? Boise, ID.

Future Electric Utility Regulation Series

- A series of reports from Berkeley Lab taps leading thinkers to grapple with complex regulatory issues for electricity
- Unique multi-perspective approach highlights different views on the future of electric utility regulation and business models and achieving a reliable, affordable, and flexible power system to inform ongoing discussion and debate
- Primary funder of initial six reports: U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability - Electricity Policy Technical Assistance Program
- Office of Energy Efficiency and Renewable Energy's Solar Energy Technologies Office is co-funding new reports under DOE's Grid Modernization Initiative
- Expert advisory group provides guidance and review (see extra slides)

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Reports published so far

1. *Distributed Energy Resources (DERs), Industry Structure and Regulatory Responses*
2. *Distribution Systems in a High DER Future: Planning, Market Design, Operation and Oversight*
3. *Performance-Based Regulation in a High DER Future*
4. *Distribution System Pricing With DERs*
5. *Recovery of Utility Fixed Costs: Utility, Consumer, Environmental and Economist Perspectives*
6. *The Future of Electricity Resource Planning*
7. *The Future of Centrally-Organized Wholesale Electricity Markets*
8. *Regulatory Incentives and Disincentives for Utility Investments in Grid Modernization*

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